Severe acute respiratory syndrome (SARS) was first detected late last year and is believed to have originated in southern China. This new disease is resistant to standard treatments and has put health authorities worldwide in a spin to find ways to curb the intensifying outbreak.

AP Photos/World Health Organistion/CNN Graphics

HUNAN
JIANGXI
GUANGXI ZHUANGAUTONOMOUS REGION
GUANDONG
Nanxiong
Shaoguan
Mexian
Guangzhou
Shenzhen
Hong Kong
Macau
Yangjiang
Maoming
Zhanjiang
SOUTH CHINA SEA

Date: 10 Feb 2003

From: Stephen O. Cunnion, MD, PhD, MPH

This morning I received this e-mail and then searched your archives and found nothing that pertained to it. Does anyone know anything about this problem?

"Have you heard of an epidemic in Guangzhou? An acquaintance of mine from a teacher's chat room lives there and reports that the hospitals there have been closed and people are dying."

- --

Stephen O. Cunnion, MD, PhD, MPH

International Consultants in Health, Inc

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International Trademart
Argyle St.
Sai Yeung Choi St.
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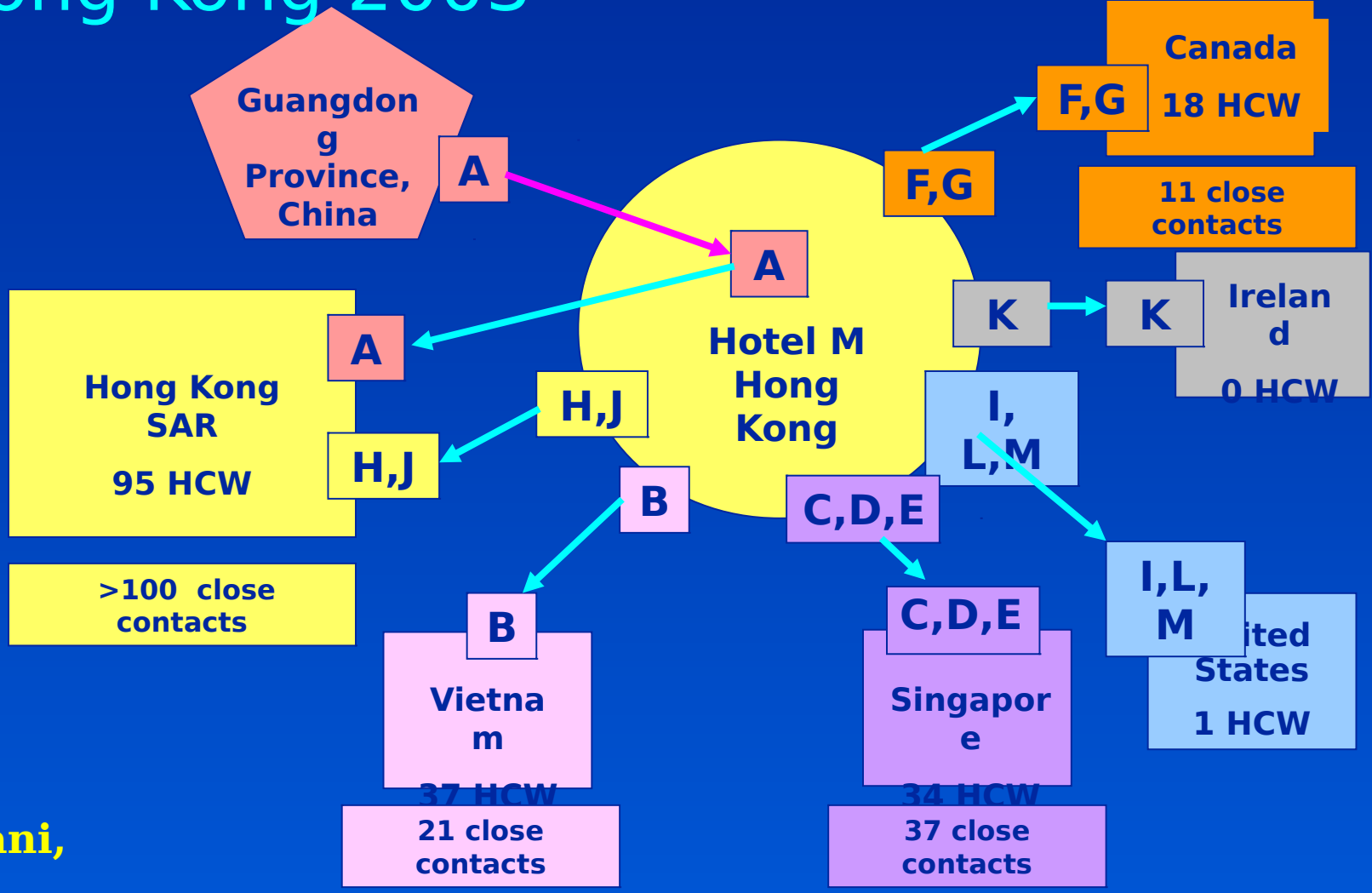
MONG KOK
Princess Margaret Rd.
Ma Tau Wai Rd.
Kowloon City Rd.
To Kwa Wan Rd.
Jordan Rd.
HUNG HOM
Railway Station
TST East
Canton Rd.
TSIM SHA TSUI
Chatham Rd.
KOWLOON
Ocean Terminal
Middle Rd.
Star Ferry Pier
Salisbury Rd.
New World Centre
Cross-Harbour Tunnel
N

Chain of Transmission among guests at Hotel M

Hong Kong 2003



Chotani, 2003

How a case of SARS develops

Severe acute respiratory syndrome begins as a flu-like illness but can deepen quickly into a life-threatening lung infection

Recovery...

DAY 1 5 10 15 20 DEATH

Infection

Incubation

First symptoms

- Fever of 100.4 F or more
- Chills, aches, weakness

Respiratory symptoms

Begin 3 - 7 days after 1st symptoms

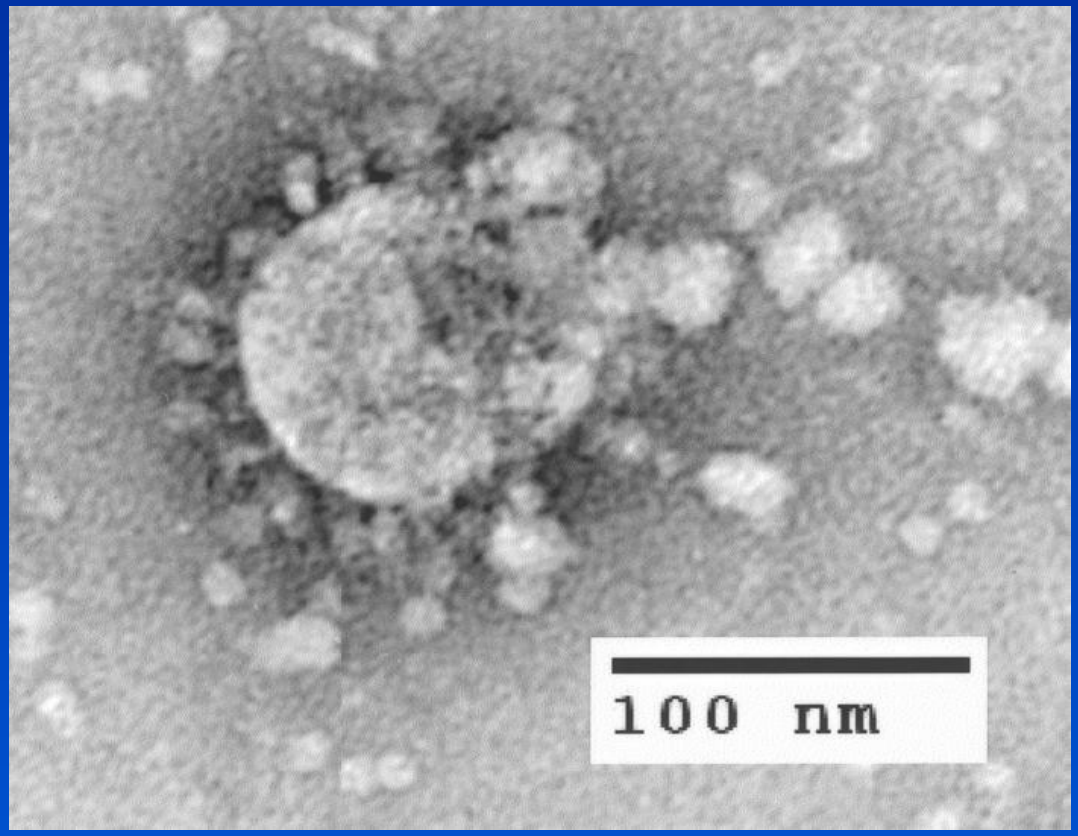
- Dry cough, shortness of breath, difficulty breathing

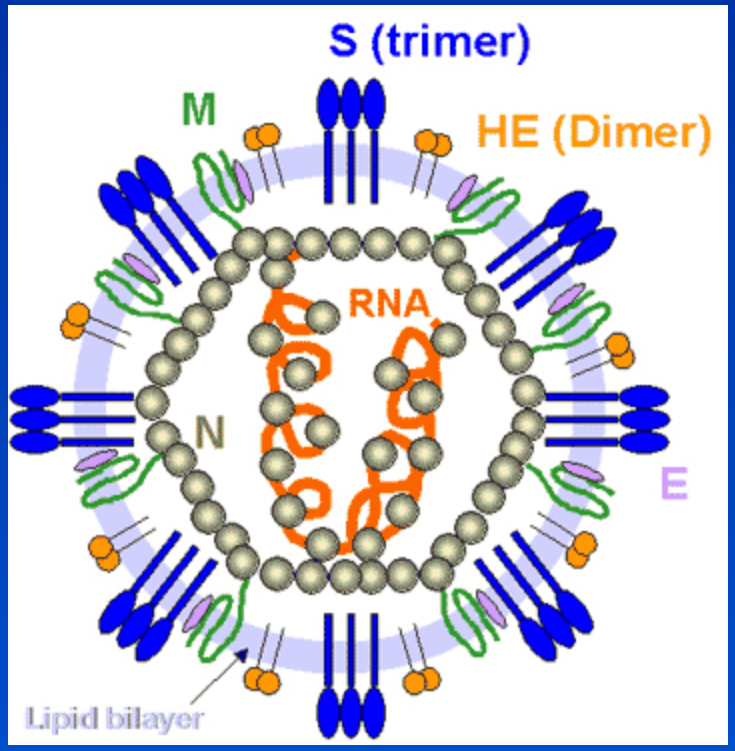
...or Crisis

Initial SARS Case Definition

- A fever over 38°C *AND*
- Cough, shortness of breath, difficulty breathing *AND*
- Close contact with someone diagnosed with SARS or a history of travel to affected areas, including Toronto, Vancouver, Guangdong province in China, Hong Kong, Singapore and Hanoi, Vietnam.

SARS-Associated Coronavirus

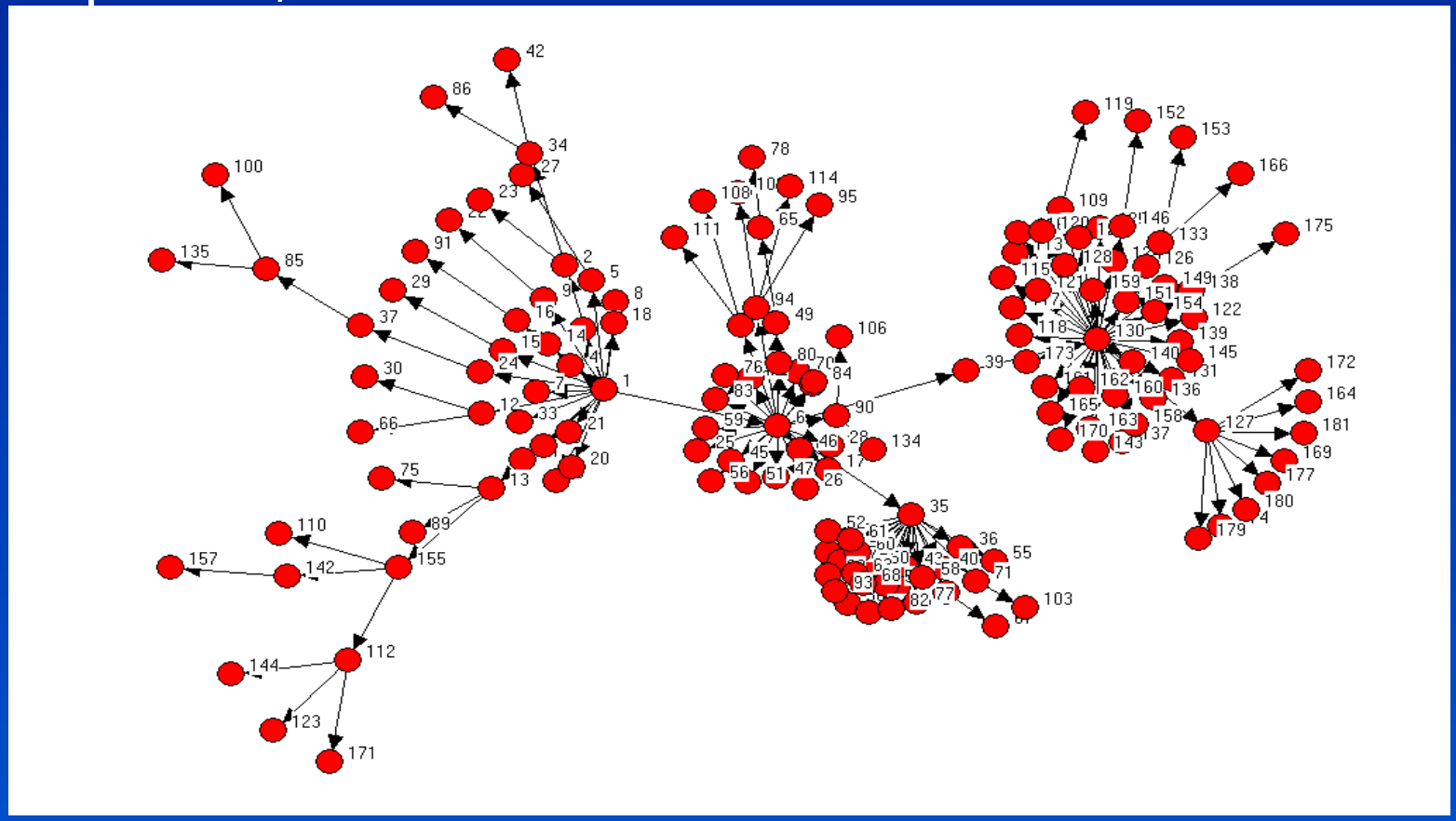




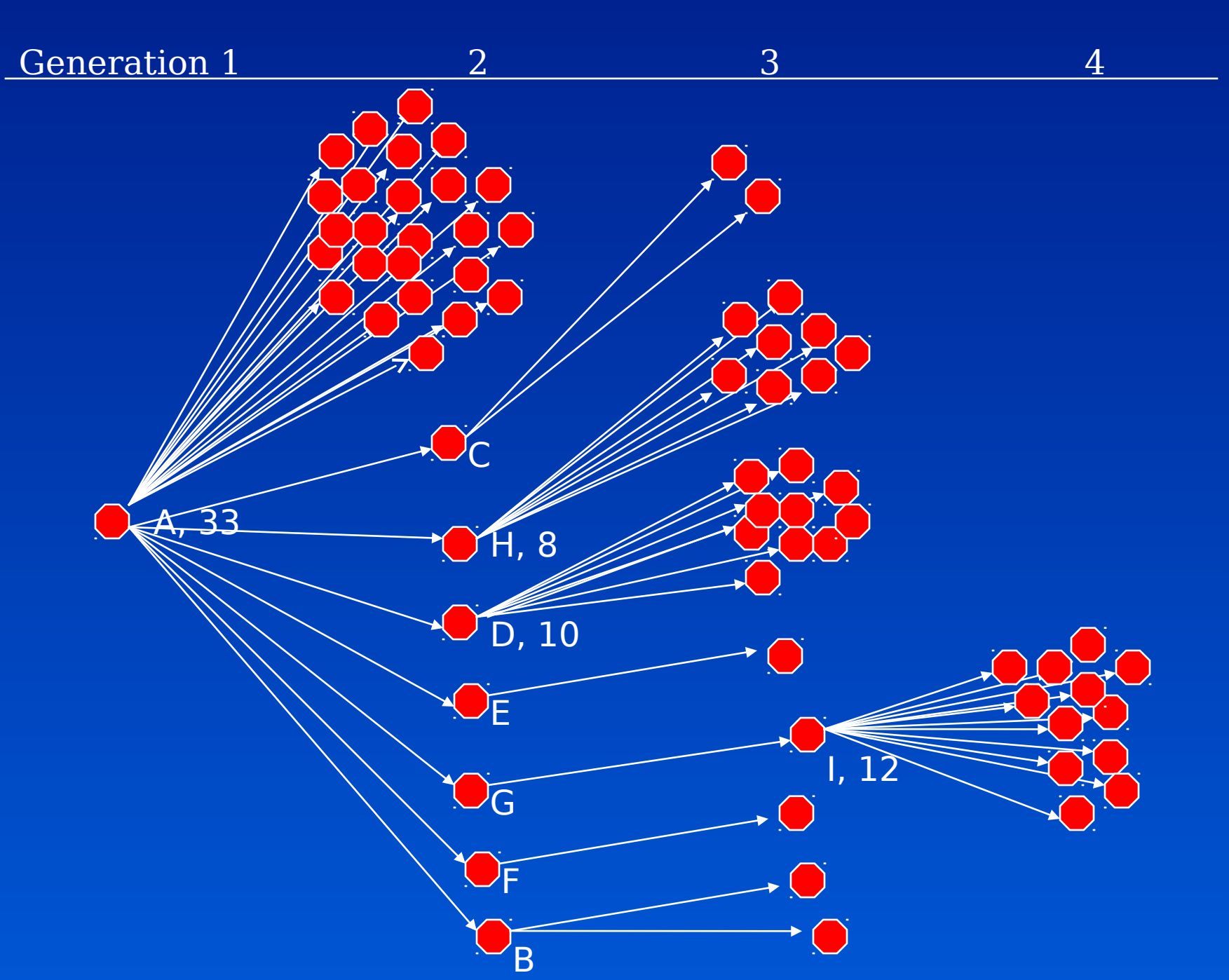
Coronavirus Family

- Cause mild to moderate respiratory illnesses – common cold
- Mutate easily
- Each mutation triggers epidemic of respiratory disease.
- Major outbreaks occur every few years with a cycle that depends on the type of virus involved.

Probable cases of severe acute respiratory syndrome, by reported source of infection,* --- Singapore, February 25--April 30, 2003



*Case 1 = 1; Case 2 = 6; Case 3 = 35; Case 4 = 130; and Case 5 = 127. Excludes 28 cases with either no or poorly defined direct contacts or who were cases translocated to Singapore with no further secondary transmission. MMWR 2003;52:405


Generation 1
2
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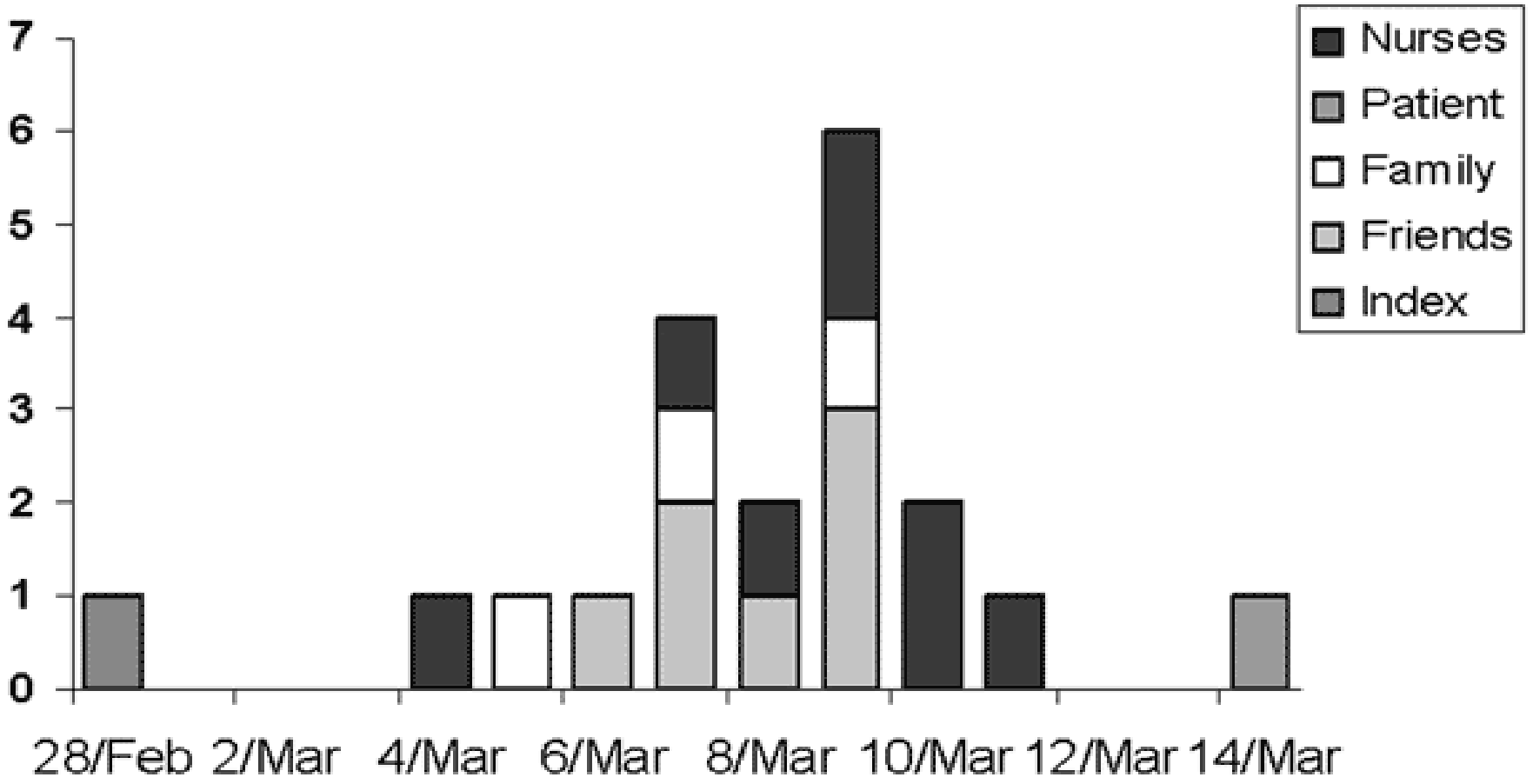
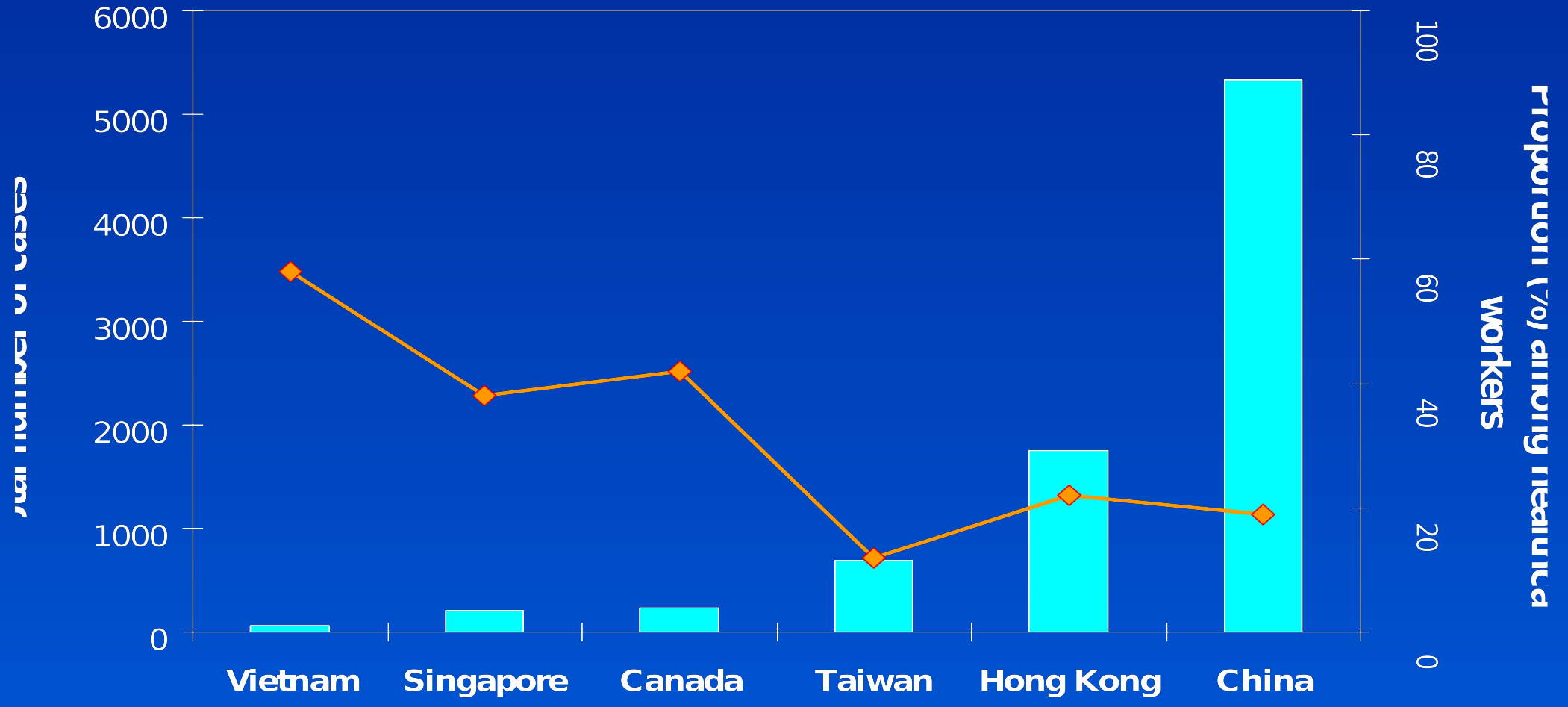
A, 33
C
H, 8
D, 10
E
I, 12
G
F
B

Index and contact cases of severe acute respiratory syndrome (SARS), by date of



Cumulative cases of severe acute respiratory syndrome



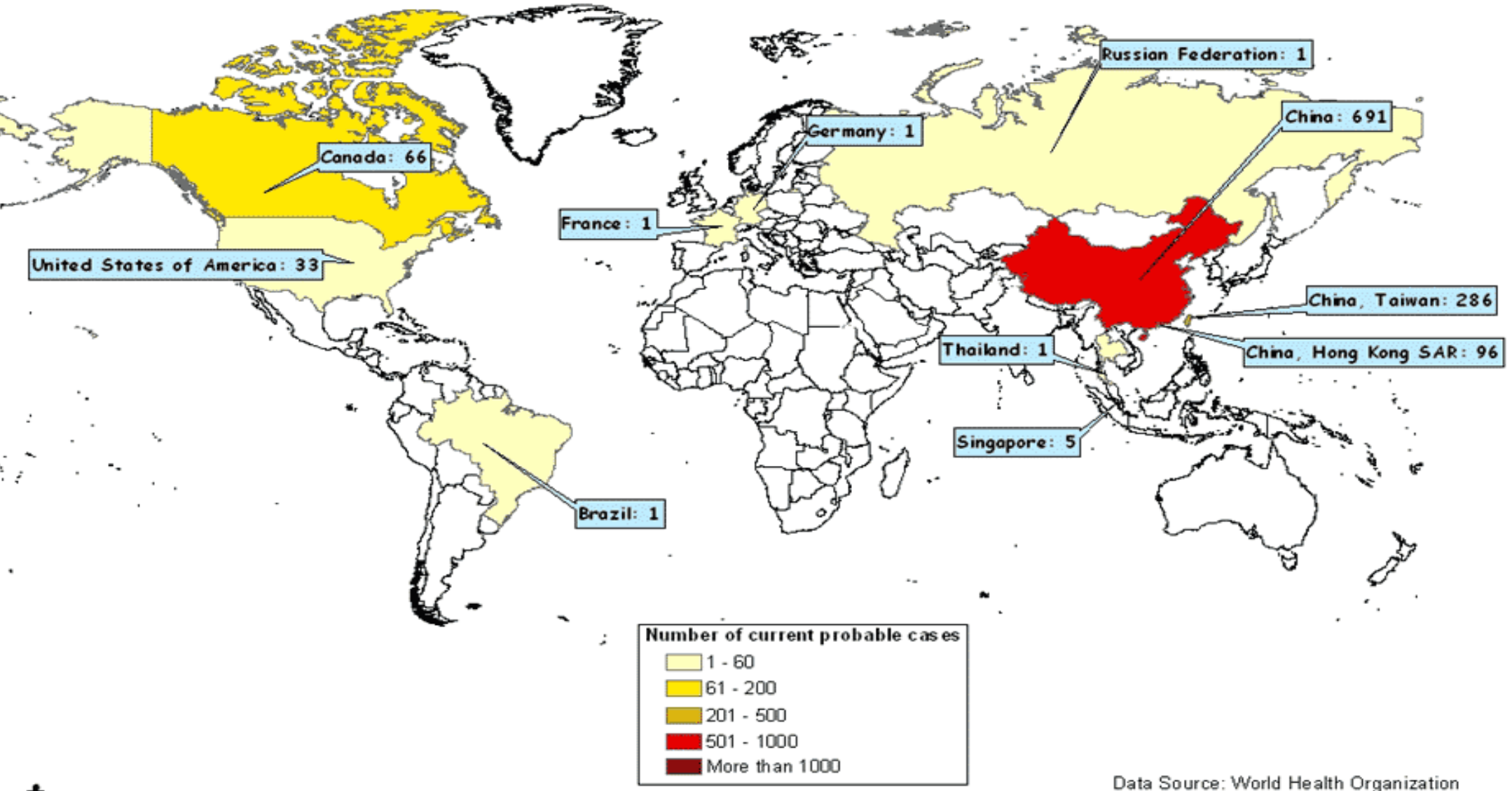
Jiang Wu, *EID*, Feb 2004

Table 2. Factors significantly associated with acquisition of clinically diagnosed SARS in multivariate analysis[a]

Potential risk or protective factor for SARS	Matched OR (95% CI)[a]	p value
Healthcare related		
Visited any fever clinic[b]	12.7 (3.1 to 52.0)	<0.001
Having any chronic disease	4.8 (1.7 to 13.2)	0.002
Visited any farmer's market	0.4 (0.2 to 0.8)	0.01
Eating out		
Never	Reference	
Once a week	1.6 (0.7 to 3.8)	0.3
More than once a week	3.1 (1.2 to 7.7)	0.02
Taking a taxi		
Never	Reference	
Once a week	0.2 (0.1 to 0.8)	0.02
More than once a week	3.0 (0.9 to 10.3)	0.07
Had a pet	0.4 (0.2 to 0.9)	0.03
Wore a mask when going out		
Never	Reference	
Sometimes	0.4 (0.2 to 0.9)	0.03
Always	0.3 (0.1 to 0.6)	0.002

[a]OR, odds ratio; CI, confidence interval; SARS, severe acute respiratory syndrome.
[b]Fever clinics were established for triage of patients who might have SARS to separate them from other persons being evaluated in emergency rooms or outpatient clinics.

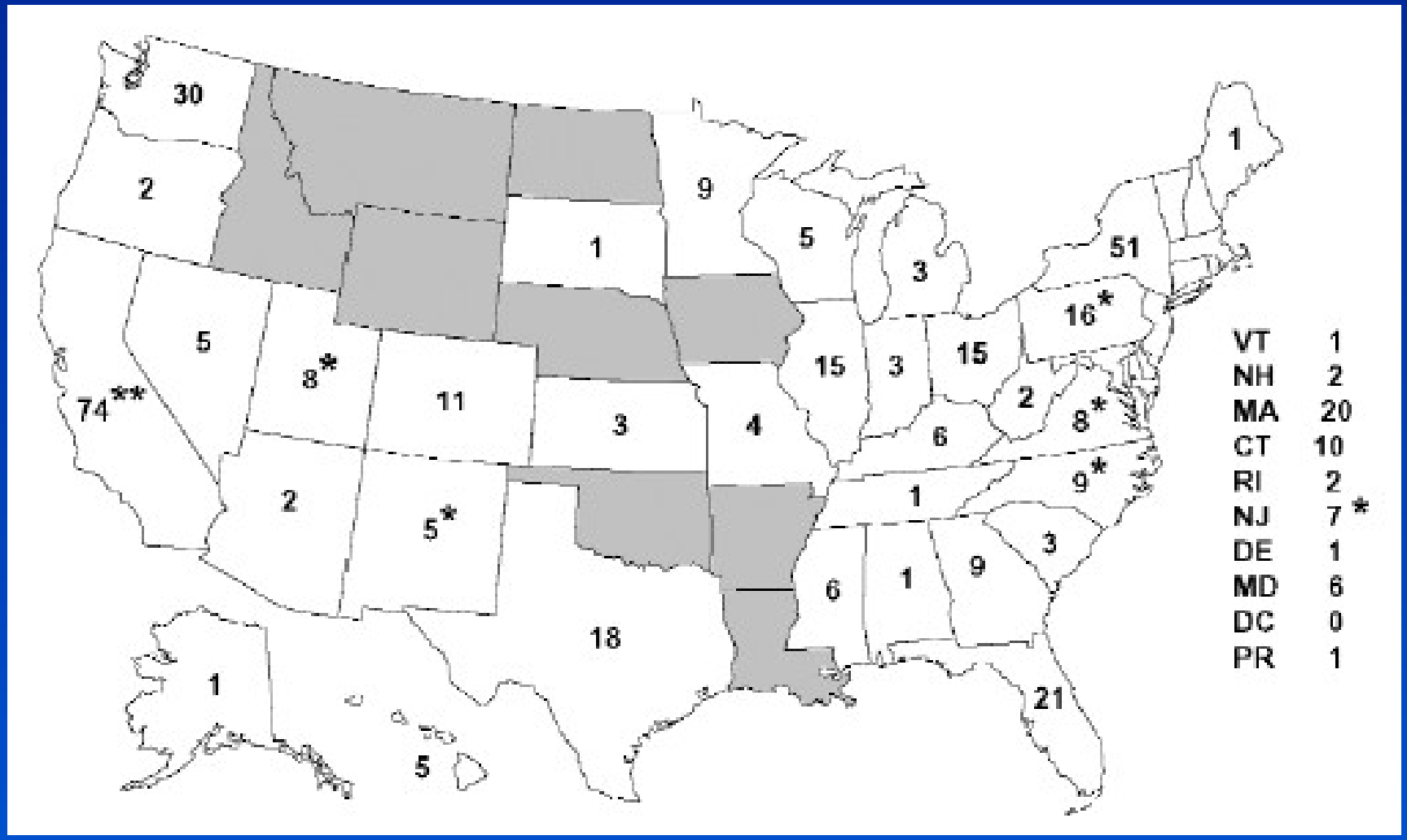
SARS: Number of Current Probable Cases as of 10 June 2003, 16:00 GMT+2



The presentation of material on the maps contained herein does not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or areas or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Data Source: World Health Organization
Map Production: Public Health Mapping Team
Communicable Diseases (CDS)

©World Health Organization, June 2003


30
2
5
74**
8*
11
2
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18
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21
VT 1
NH 2
MA 20
CT 10
RI 2
NJ 7*
DE 1
MD 6
DC 0
PR 1

Lessons Learned: Key Epidemiologic Features

- SARS can spread rapidly around the world
- Healthcare facilities played central role
- Most cases were spread person-to-person
- Vast majority of febrile respiratory infections in U.S. were not SARS

Case-Fatality Proportion

As of June 10

Hong Kong	290/1754	16.5%
Singapore	31/206	15.0%
Canada	32/229	14.0%
Taiwan	81/686	11.8%
Viet Nam	5/63	7.9%
China	343/5328	6.4%
USA	0/66	0.0%

Overall CFP= 9.4% (range 0%-16.5%)

Chotani, 2003

Source: WHO

SARS – case fatality rate

Age (years)	Mortality (%)
≤ 24	< 1
25 – 44	6
45 – 64	15
≥ 65	> 50

Case classification
CDC July 31,2003

- Probable case: meets the clinical criteria for severe respiratory illness of unknown etiology and epidemiologic criteria; laboratory criteria confirmed or undetermined
- Suspect case: meets the clinical criteria for moderate respiratory illness of unknown etiology and epidemiologic criteria; laboratory criteria confirmed or undetermined

Clinical Case Definition

CDC July 31 2003

- Asymptomatic or mild respiratory illness
- Moderate respiratory illness
  - temperature of >100.4º F (>38º C)*, and
  - one or more clinical findings of respiratory illness
- Severe respiratory illness
  - temperature of >100.4º F (>38º C)*, and
  - one or more clinical findings of respiratory illness, and
  - radiographic evidence of pneumonia, or
  - respiratory distress syndrome, or
  - autopsy findings consistent with pneumonia or respiratory distress syndrome without an identifiable cause.

Epidemiological Case Definition

CDC July 31,2003

- Travel (including transit in an airport) within 10 days of onset of symptoms to an area with current or previously documented or suspected community transmission of SARS

  or

- Close contact within 10 days of onset of symptoms with a person known or suspected to have SARS

Laboratory Case Definition

CDC July 31,2003

- **Confirmed**
  - Detection of antibody to SARS-CoV in specimens obtained during acute illness or >21 days after illness onset, or
  - Detection of SARS-CoV RNA by RT-PCR confirmed by a second PCR assay, by using a second aliquot of the specimen and a different set of PCR primers, or
  - Isolation of SARS-CoV.
- **Negative**
  - Absence of antibody to SARS-CoV in convalescent serum obtained >21 days after symptom onset.
- **Undetermined**
  - Laboratory testing either not performed or incomplete.

Exclusion criteria

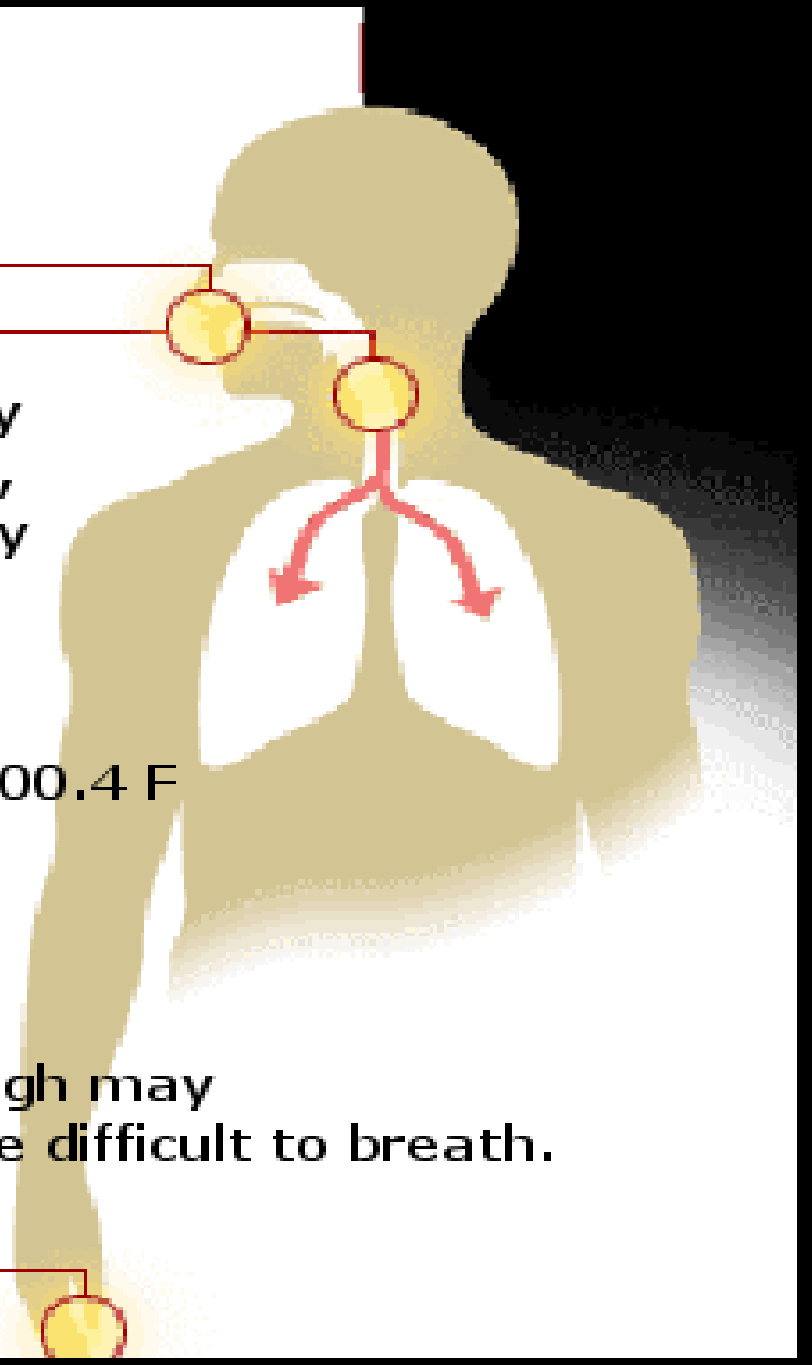
CDC July 31,2003

A case may be excluded as a suspect or probable SARS case if:

- An alternative diagnosis can fully explain the illness
- The case was reported on the basis of contact with an index case that was subsequently excluded as a case of SARS (e.g., another etiology fully explains the illness) provided other possible epidemiologic exposure criteria are not present

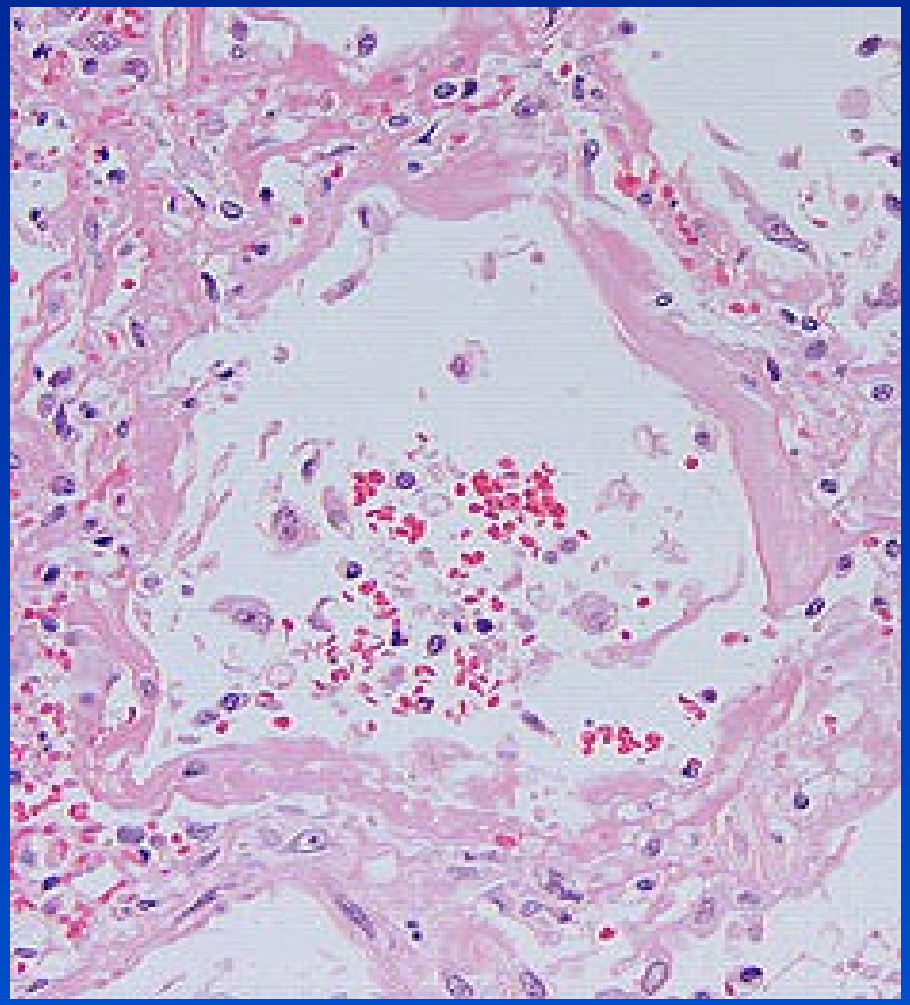
INSIDE THE BODY

The virus replicates in the respiratory tract and moves down into the lungs, possibly leading to severe respiratory distress.

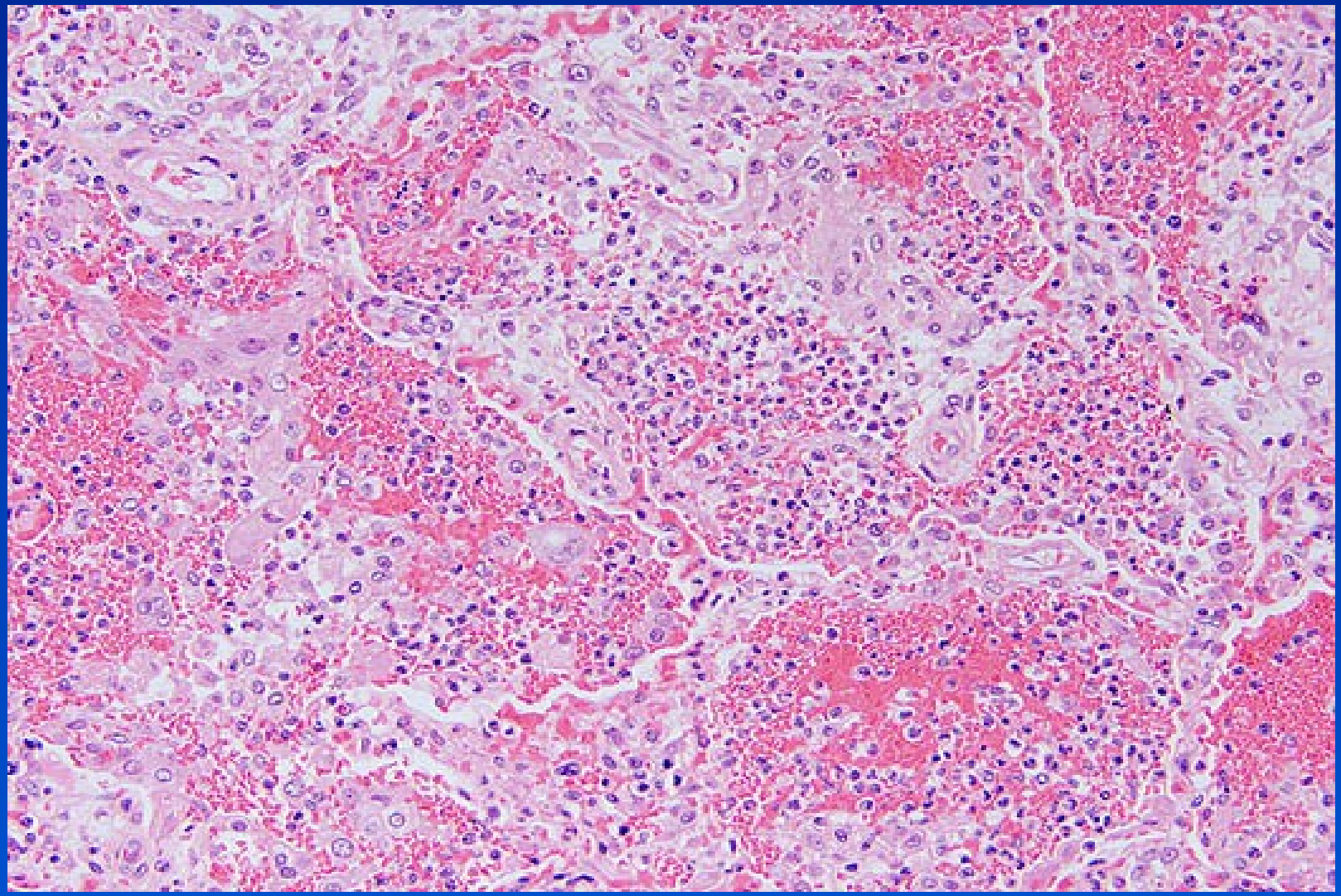


SYMPTOMS

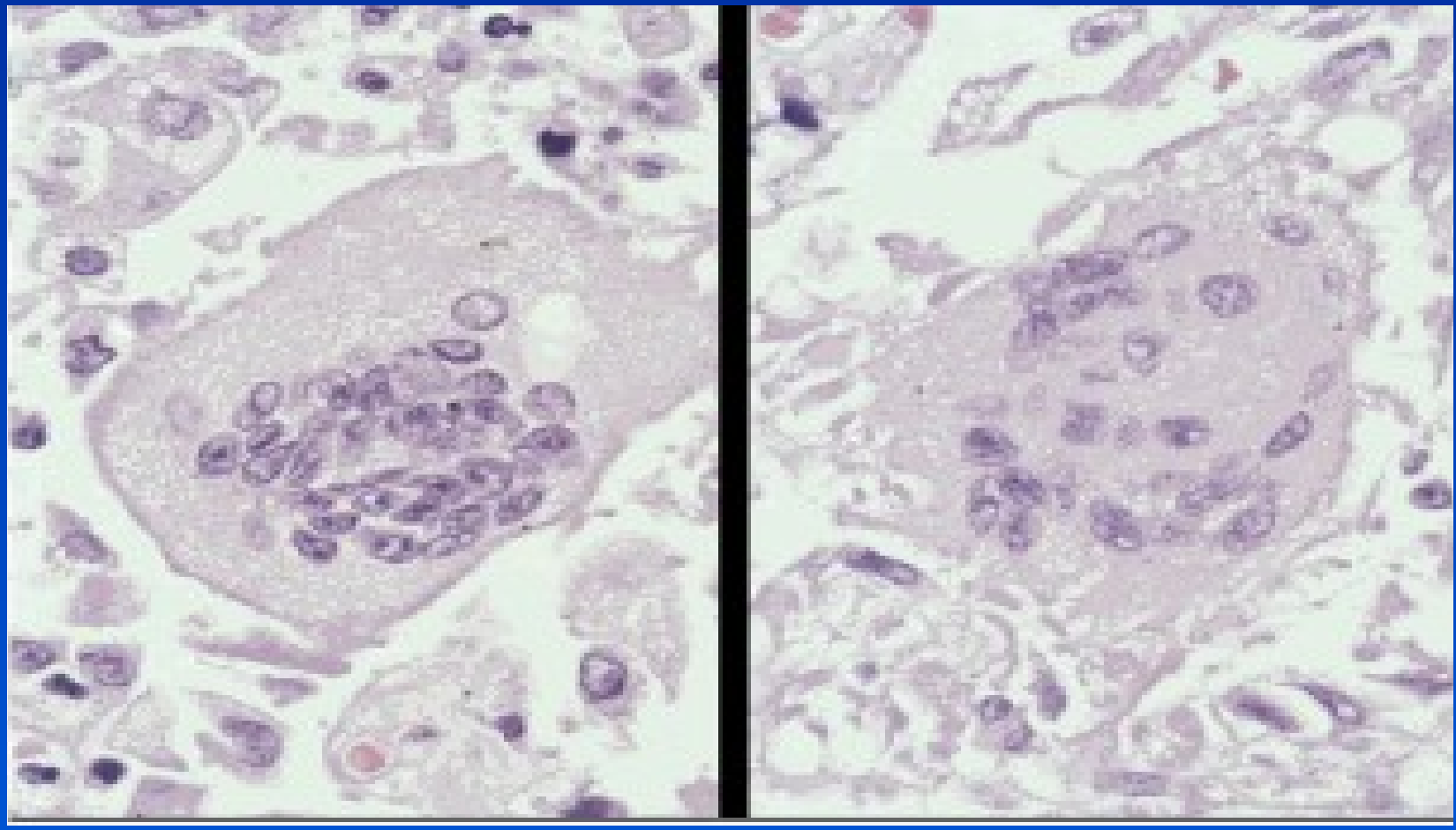
- Begins with a fever greater than 100.4 F
- Headache
- Overall feeling of discomfort
- Body aches
- Mild respiratory symptoms
- After two to seven days, a dry cough may develop. It may also become more difficult to breath.



Homogeneous appearing hyaline membranes line alveolar walls in DAD (Diffuse Alveolar Damage)



Multinucleated syncytial giant cells in lung of SARS patient



Day 5

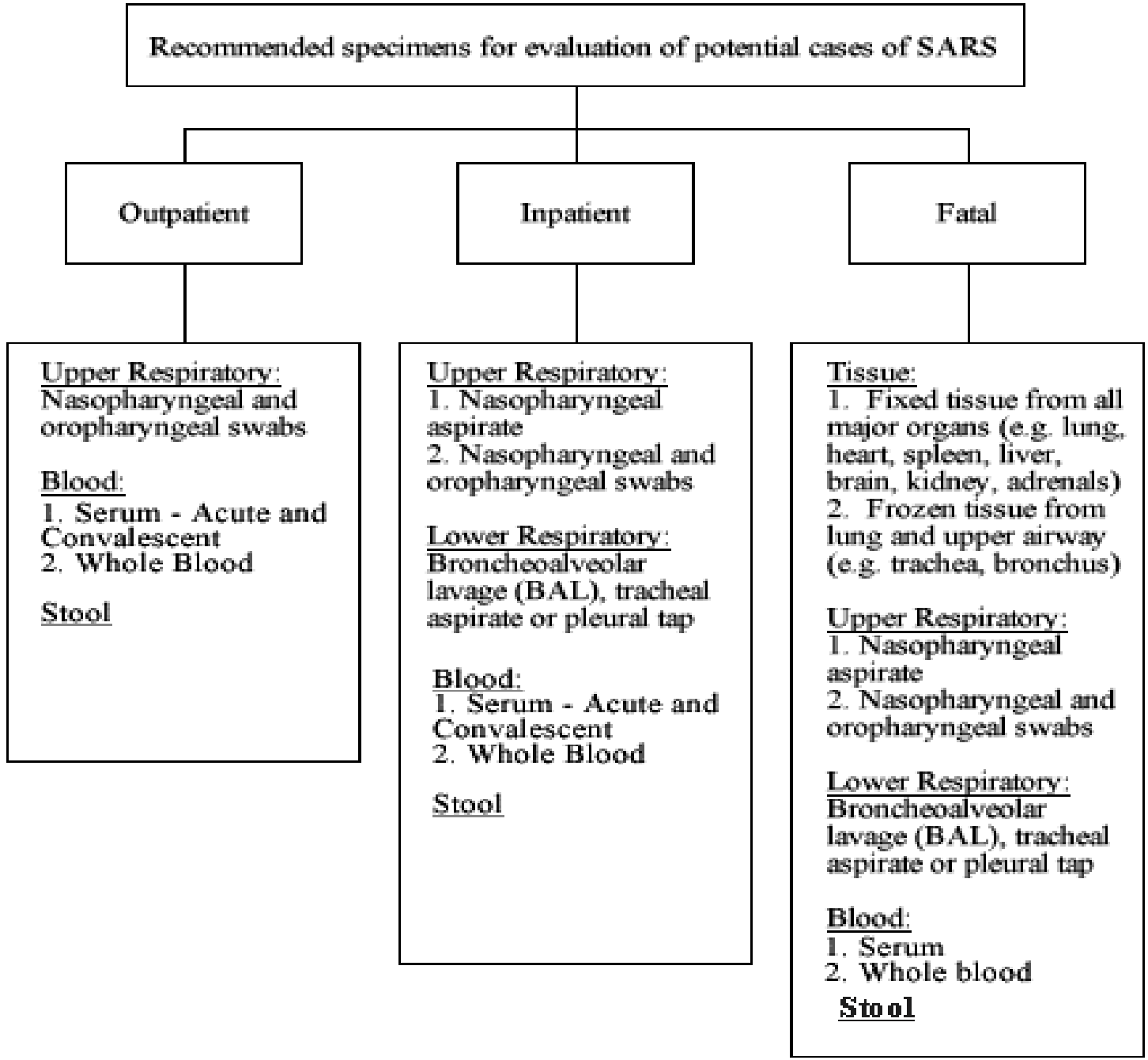
Day 10

Day 13

Day 15

Laboratory Diagnosis

- Detection of serum antibody to SARS-CoV *or*
- Isolation in cell culture of SARS-CoV from a clinical specimen, and PCR confirmation using a test validated by CDC, *or*
- Detection of SARS-CoV RNA by a reverse transcription-polymerase chain reaction (RT-PCR) test validated by CDC from
  - One specimen tested on two occasions using the original clinical specimen on each occasion, *or*
  - Two clinical specimens from different sources (e.g., nasopharyngeal and stool), *or*
  - Two clinical specimens collected from the same source on 2 different days (e.g., 2 nasopharyngeal aspirates).


Recommended specimens for evaluation of potential cases of SARS
Outpatient
Inpatient
Fatal
Upper Respiratory:
Nasopharyngeal and oropharyngeal swabs
Blood:
1. Serum - Acute and Convalescent
2. Whole Blood
Stool
Upper Respiratory:
1. Nasopharyngeal aspirate
2. Nasopharyngeal and oropharyngeal swabs
Lower Respiratory:
Broncheoalveolar lavage (BAL), tracheal aspirate or pleural tap
Blood:
1. Serum - Acute and Convalescent
2. Whole Blood
Stool
Tissue:
1. Fixed tissue from all major organs (e.g. lung, heart, spleen, liver, brain, kidney, adrenals)
2. Frozen tissue from lung and upper airway (e.g. trachea, bronchus)
Upper Respiratory:
1. Nasopharyngeal aspirate
2. Nasopharyngeal and oropharyngeal swabs
Lower Respiratory:
Broncheoalveolar lavage (BAL), tracheal aspirate or pleural tap
Blood:
1. Serum
2. Whole blood
Stool

Therapy

?

SARS and Domestic Preparedness

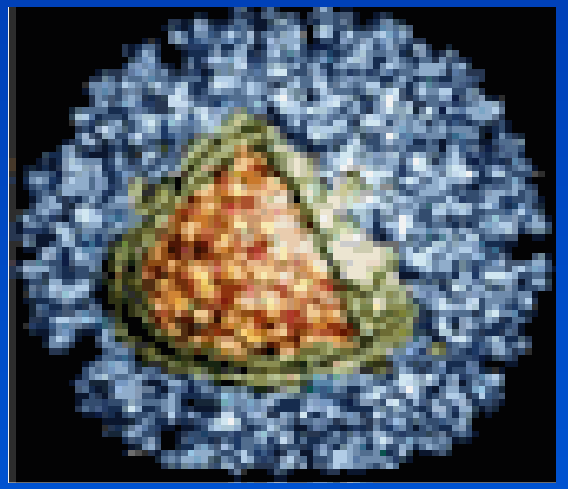
New!

SARS Protection2.2 .3M™ Half Facepiece Respirator

Easy-to-use, 6000 Series Half Facepiece Respirator. Attach the filters or cartridges directly to facepiece. Low-profile design affords better visability and allows safety glasses to be worn. Lightweight and features a soft facepiece and an adjustable head strap. Available in sizes small, medium (Fits 90% of population), and large. 1 pack of P100 Organic Vapor Cartridges (ANI part 14404) required.

Coronovirus Family

- Able to survive in dry air and on surfaces for up to 3 hours
- Dried virus crystallizes and can float in air like dust
- Can be killed by exposure to ultraviolet light



Transmission of SARS

- SARS spreads mostly by close person-to-person contact.
- Most cases have involved people who cared for or lived with someone with SARS
- SARS appears to be less infectious than influenza
- The virus can also be spread by touching contaminated surfaces then touching eyes, nose, or mouth
- It is possible that SARS could be spread more broadly through the air or by other ways currently unknown.

Infection Control

- Early recognition and isolation is key
  - Heightened suspicion
  - Triage procedures
- Transmission may occur during the early symptomatic phase
  - Potentially ***before*** both fever and respiratory symptoms develop

First Line of Response: Astute Clinician

Screen all persons being hospitalized for CXR-confirmed pneumonia:

1. In the last 10 days, have you **traveled** to mainland China, Hong Kong or Taiwan*, or been in close contact with other ill persons who have?

2. “Are you employed as a **healthcare worker** with direct patient contact?”

3. “Do you have **close contacts** who have been told they have pneumonia?”

Surveillance recommendations

- Report cases to the health department to aid recognition of clusters of unexplained pneumonia.
- SARS testing should be used judiciously, in consultation with public health representatives.

Surveillance in the presence of SARS

- If SARS comes back, surveillance must expand.
- Screen all patients with fever or respiratory symptoms (not just those admitted) for known risks, especially travel to areas where SARS is active OR contact with a SARS patient.

Infection control measures

- Make sure HCWs understand the importance of basic infection control practices like isolation and hand hygiene (whether there is SARS or not!).

Infection Control
Precautions

- Standard
- Contact
- Droplet
- Airborne

Infection control measures

- Consider adopting a universal, “respiratory hygiene/cough etiquette” strategy.
- Common and important pathogens are transmitted by respiratory secretions: influenza, pertussis, mycoplasma.
- Controlling respiratory secretions can help reduce transmission.

Respiratory hygiene/ Cough etiquette

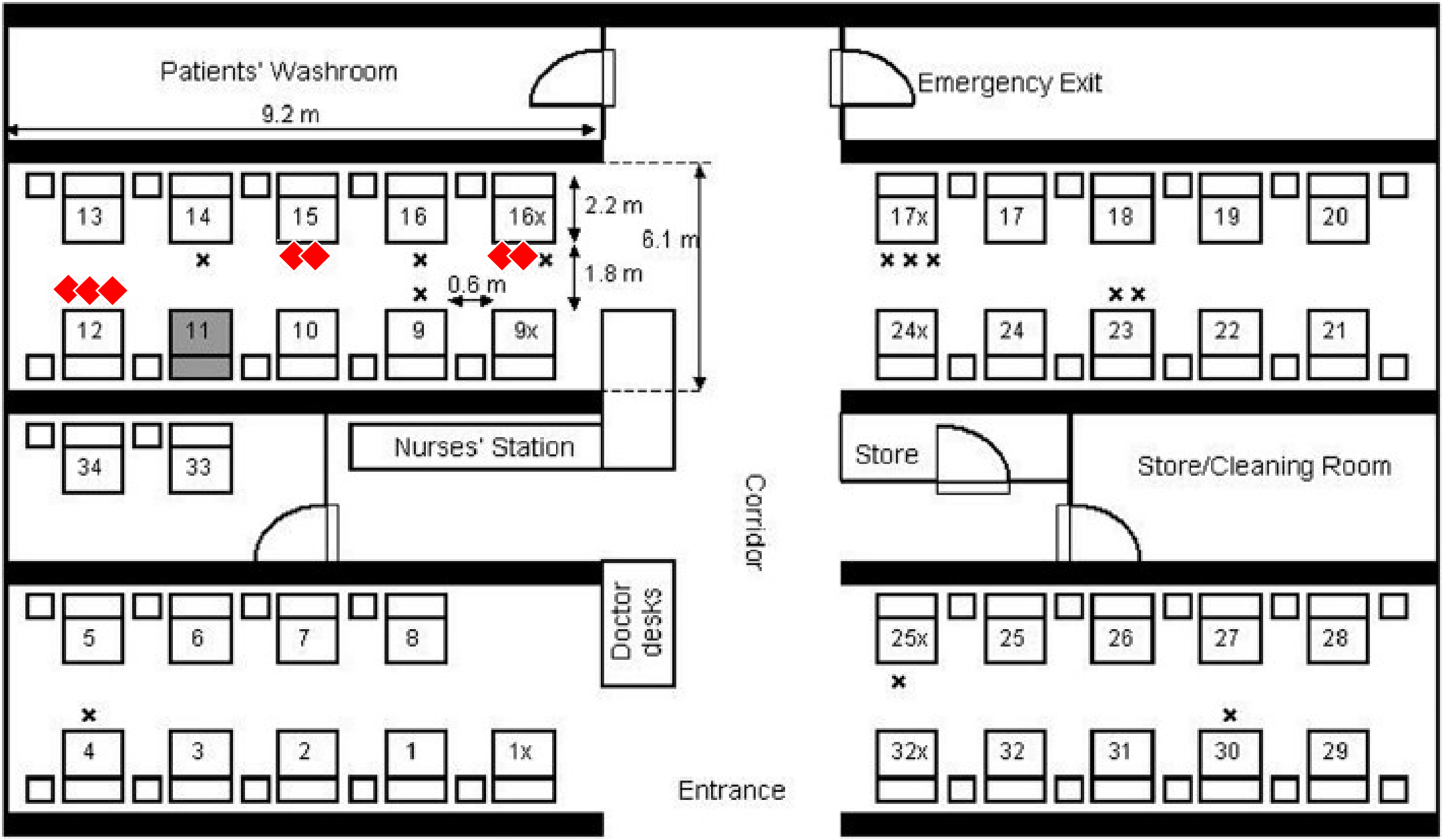
- Encourage patients to alert staff if they are suffering febrile respiratory illness.
- Give patients a surgical mask to wear or tissues to cover their noses and mouths.
- Encourage patients to practice hand hygiene after touching their faces.

Respiratory hygiene/ Cough etiquette

- Separate patients with febrile respiratory illness from other patients in the waiting area.
- Manage patients using droplet precautions until it is determined the cause of the respiratory illness is a pathogen that does not require precautions.

Patient isolation

- Though most transmission appears to occur from infectious droplets, there are infrequent episodes where airborne transmission cannot be excluded.
- CDC recommends that SARS patients be managed with *airborne PLUS contact precautions*.


Patients' Washroom
9.2 m
Emergency Exit
13
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15
16
16x
2.2 m
6.1 m
1.8 m
0.6 m
17x
17
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10
9
9x
24x
24
23
22
21
34
33
Nurses' Station
Store
Store/Cleaning Room
Corridor
Doctor desks
5
6
7
8
25x
25
26
27
28
4
3
2
1
1x
Entrance
32x
32
31
30
29

Relative risk of critical care nurses acquiring SARS by patient care activity

Patient care activity	Relative risk (95% CI)	p value
Intubation	4.20 (1.58 to 11.14)	0.04
Suctioning before intubation	4.20 (1.58 to 11.14)	0.04
Manipulation of O2 mask	9.00 (1.25 to 64.89)	0.01
Suctioning after intubation	0.68 (0.21 to 2.26)	0.68
Manual ventilation	1.19 (0.30 to 4.65)	1.00
Insertion of nasogastric tube	1.44 (0.38 to 5.47)	0.62
Insertion of urinary catheter	5.00 (2.44 to 10.23	0.06
Bathing or patient transfer	1.62 (0.24 to 10.78	1.00
Bronchoscopy	2.14 (0.46 to 9.90)	0.44

Loeb M, *EID*, Vol. 10, 2004

Nurses' risk of acquiring SARS based on use of personal protective equipment

Type of PPE	RR (95% CI)	p
Gown	.36 (0.10 to 1.24)	.12
Gloves	.45 (0.14 to 1.46)	.22
N95 or surgical	.23 (0.07 to 0.78)	.02
N95 mask	.22 (0.05 to 0.93)	.06
Surgical mask	.45 (0.07 to 2.71)	.56
N95 vs surgical	.50 (0.06 to 4.23)	.51

Loeb M, *EID*, Vol. 10, 2004

Airborne isolation

- Potential SARS patients should be placed in airborne infection isolation or negative pressure rooms.
- Healthcare workers should wear a fit-tested N95 (or higher) respirator or personal air purifying respirator (PAPR) in addition to gowns, gloves and eye protection.

Patient cohorting

- Some facilities have few (or no) negative pressure rooms.
- Facilities will need to decide at what point they will choose to cohort patients onto a “SARS unit” in private, but non-negative pressure, rooms.

Advantages of a SARS unit

- Focuses SARS related resources in one area.
- Physically separates SARS patients from others.
- Was an effective strategy in parts Toronto and Taiwan.

Intubation of SARS patients

- Ongoing assessment of patients to determine when intubation is likely to be necessary,
- Limiting the number of persons in the room during intubation,
- Intubation should be performed by the most experienced personnel available.
- Procedures such as sedating the patient which will limit the duration of the intubation.

Infection Control for Persons with SARS*

- Avoid interactions outside the home (school, work, day care, church, shopping)
- Wear surgical mask and avoid public transportation if travel outside home is necessary
- Limit persons coming into the home

*** Including persons who have not been diagnosed with SARS but have SARS symptoms**

Infection Control Advice to SARS Patients

- ***Wear a surgical mask*** when in the presence of other household members
- ***Contain respiratory secretions*** in facial tissue and place in lined container for disposal with household waste
- ***Perform hand hygiene*** frequently and especially after touching respiratory secretions and other body fluids (e.g., urine, stool)

Advice to Household Members of SARS Patients

- Wear surgical mask when around SARS patient (if patient cannot wear mask)
- Perform hand hygiene frequently (hand washing with soap and water or use of alcohol-base gel)
- Consider wearing disposable gloves for direct contact with body fluids of SARS patients

Other Infection Control Measures in the Home

- Do not share personal items until thoroughly washed with soap and water (towels, linen, eating utensils)
- Consider separate sleeping arrangements
- Clean surfaces that are touched frequently or come into contact with body fluids (e.g., food preparation areas, phones, lavatories)

Anticipatory Guidance for SARS Patients

- How will they get food and other supplies (e.g., surgical masks)?
- How will they travel to and from necessary appointments (e.g., medical)
- How will they deal with family members who are afraid?

Prevention is Primary!

Date: 5 Jul 2003

From: ProMED-mail <promed@promedmail.org>

Source: WHO SARS website [edited]

<http://www.who.int/csr/don/2003_07_05/en/>

With the last known chain of transmission interrupted in Taiwan, the whole world can breathe an initial sigh of relief," said Dr David Heymann, the WHO Executive Director for communicable diseases. "At the same time, public health must not let down its guard, as more cases could still surface somewhere in the world. SARS has taught us that a single case is capable of igniting an outbreak.